This article focuses on the emergence of water pollution problems in the city of Malmö and on how they were discussed and solved. Various countermeasures were proposed and considered, but finally the discharge of wastewater into the Sound of Öresund was regarded as the best solution. As a result, a local pollution problem was transformed into a regional issue. The solutions adopted in Malmö are briefly compared with decisions made in Gothenburg and Stockholm.

INTRODUCTION
The Sound of Öresund (hereafter called Öresund) connects the Baltic Sea and the Atlantic Ocean and separates Sweden and Denmark. Already in the 1940s drastic changes were noted in the bottom flora and fauna of Öresund, and the bathing resorts were suffering from deteriorating water quality. To understand these changes and the resulting problems, one has to study their background in the environmental politics of the cities around Öresund.

This study focuses on the third largest city in Sweden, Malmö, which is located on the eastern shore of Öresund. Malmö serves as an example of a city whose rapid population growth and industrial development at the end of the 19th century came to affect first its urban watercourses and finally the coastal zone of the strait. This article focuses on the ensuing discussion and the measures taken in the struggle against water pollution. It identifies the factors that determined the measures taken or, and no less important, not taken. It explores the roles played by various groups of people, individual townspeople, politicians, and experts in technology and health care in this context, and it discusses how conflicts of interest were settled. As this study concentrates on the history of local environmental politics, it is based on primary source material from the city of Malmö archives (CMA). This is the first article written on the history of water pollution and protection in Malmö in 1850–1911, which is the time when the pollution of waterbodies and related solutions were being discussed in the city.

A STINKING CANAL
Malmö is located on the shores of Lomma Bay, which is part of Öresund. Sewerage canals were dug in the city center at the beginning of the 19th century. The only local river, the small Sege River, runs beyond the city center. In 1850, Malmö was a small town with approximately 13,000 inhabitants. Wealthy burghers lived in the center in brick houses, and laborers and poor people lived in crowded, cold, draughty, and damp tenement houses (1). Filth was part of everyday life. Human and animal waste was collected by farmers and utilized as fertilizer, but leaking privies and stables caused a stench. Attempts were made to get rid of this stench by building gutters, which conducted the wastewater to drainage or infiltration ditches.

The central canal served as the main recipient of the wastewater. Soon this shallow (about 1 m deep) and narrow (about 6 m wide) canal started to stink, and was considered to "give rise to dreadful consequences" (2) and be "hazardous to health" (3). The canal was cleaned on several occasions, and a
lock was also constructed to replace the putrid canal water with fresh seawater. But, due to the growing population, an increasing amount of wastewater ended up in the canal. The pollution of the canal was considered so serious that the city administration summoned the citizens to a meeting in January 1852. All participants, wealthy burghers as well as ordinary craftsmen, agreed that something had to be done. It was decided to widen and dredge the canal thoroughly. The width would be from approximately 6 to 15 m and depth from 1 to 2 m. It was also decided to improve the water exchange to Öresund. In other words, Öresund was to help clean the canal, which would in turn clean the city. This project, which was funded by a special canal tax, was carried out in 1854–1859.

To understand the fear of the authorities and citizens of Malmö in regard to the stinking canal, one has to take two factors into consideration: i) the fear of epidemics; and ii) the theories relating to the transmission of disease at that time. In the summer of 1850, Malmö was severely struck by a cholera epidemic, and approximately 3% of the population died. According to the then dominating miasma theory, decaying organic matter and consequent unhealthy air caused disease. Thus, the stench from the canal was not considered to be only a nuisance, but also a source of lethal epidemics.

Population growth continued due to industrialization, and by 1880 Malmö had approximately 38,000 inhabitants and 65 industrial plants. This rapid urbanization and industrialization had a strong impact on the environment. The municipal Board of Health, established in 1858, was concerned about public health and also conscious of the canal’s water pollution problem. For instance the Board of Health tried to persuade the city administration to take action against the owner of a starch factory that was polluting the canal (4). In 1874, P. Wester, a police officer, and A. Falck, the principal city physician and chairman of the Board of Health, conducted investigations in order to identify the main polluters of the canal. Five tanneries, 3 dyeworks, a cotton-weaving mill, a woollen mill, a gasworks, and several slaughterhouses were found to be discharging their various solid and liquid waste via the gutters into the canal (5). Falck considered these discharges a threat to public health and general well-being. He proposed 2 measures: to i) forbid harmful discharges into the gutters and the canal; and ii) forbid factories causing the pollution problems to be built in the city center. The first proposal stated that the factory owners were to be obliged to "carry out precipitation and disinfection of organic and putrifying substances or otherwise collect solid waste in suitably constructed filters or sludge chambers" (5).

These proposals caused a conflict of interests. The demands of the Board of Health and the city physician for the improvement of the environment were set against the tradesmen’s and industrialists’ rights to discharge wastewater in connection with their activities. The proposed measures, which were addressed directly to the polluters, were not designed to meet with sympathy among those in authority in the city. One factor was the composition of the city council, where the leading merchants and factory owners maintained that such far-reaching demands would have a restraining influence on their businesses. Another difficulty was the weakness of national legislation on sanitary matters. New health regulations were established in 1868 and the Public Health Act was enacted in 1874, but the city administration and the Board of Health disagreed about how to interpret them. This conflict became a matter for the representative of the State at the regional level. He decided that the discharges were to be allowed during a restricted period at night, and to make the discharges innocuous provided this was possible (6).

It was easier for the city council and the city administration to discuss measures related to the effects of the pollution rather than its causes. Various measures were discussed continuously by the city council. The canal water was to be replaced by fresh seawater by ventilation and extension, various lock equipment, pumps, and a turbine were suggested. A proposal was even made to change the course of the local Sege River into the city. When a widening of the canal came up for discussion, some critical voices recalled the adverse result of the previous one. A local baker, M. Möller, who was a diligent debater on these issues, proposed at the beginning of the 1870s that the unhealthy canal should be filled up and a sewerage system should be built (7).
In fact, the City Building Committee was investigating the possibilities of building such a system. But it turned out to be too expensive (8), as a result, the canal was widened, as was the case 20 years earlier.

THE DYSENTERY EPIDEMIC

Since the 1870s the Board of Health and some private house owners had been trying to improve the water drainage system in the city by transforming drainage ditches into open gutters of dressed stone or glazed stone pipes. This development made the Board of Health realize the need for a coordinated plan for the underground pipes “or to establish a direct drainage system discharging into the sea” (9). Wastewater was not to be discharged into the canal; it was already a sanitary problem, and the problems could be expected to increase in pace with the growth of the city. Therefore, the Board of Health suggested that a comprehensive disposal plan should be drawn up for the city (9). The need for such a reform became evident in 1882.

A dysentery epidemic at the beginning of the 1880s gave additional evidence of the need to improve the public health situation in Malmö. The epidemic culminated in 1882 when 2388 people were reported ill. It was the worst dysentery epidemic in Sweden since the beginning of the 19th century. A special committee was formed to investigate the causes of the epidemic and the only professor of public health in Sweden, E. Heyman from Stockholm, was appointed chairman (10). The most important measure to be taken, according to Heyman’s report, was to dispose of all the liquid waste via a sewerage system (11). As a result, the soil would be protected against pollution, and the stench from the canal would cease. In 1882, the city council appointed a special Committee of Public Health to study the sewerage system (12). The committee contacted a Danish engineer, C. Ambt, who had worked with the sewerage system in Copenhagen. Ambt gained the confidence of the committee and presented his proposal, a partly separate sewer system (the system would be for the wastewater and only a small amount of the rainwater). The wastewater would be discharged into Öresund east of the harbor of Malmö at a depth of 1.2 m, where the current would transport it away from the city.

However, it was a long time before Malmö began to construct a sewerage system. The Borough Finance Department, which was in charge of the city’s economy, was dominated by the city’s industrial and business leaders, who were against the sewerage system. They believed that the system would be too expensive for the city and would increase the local taxes considerably. The Borough Finance Department’s reluctance was also based on the fact that there were disagreements among the experts. J.G. Richert, one of the foremost engineers in this field in Sweden, had also presented a sewerage system proposal. He recommended a combined system, and he also disagreed with Ambt about where to discharge the wastewater. Furthermore, the Borough Finance Department noted that the city was not in acute need of a sewerage system any longer – the dysentery epidemic had already abated (13). The city council of Malmö decided after a lengthy discussion in December 1886 to postpone the sewerage question.

A SEWAGE SYSTEM IS BUILT

The problems with the stench from the canal were considerable despite continual clean-up, widening and ventilation measures. A. Danielsson, a well-known social democrat and journalist in Sweden, published this vivid description in 1894:

A fresh wind blows from the sea and the fog packs closer towards land, before it is torn to pieces and disappears. The canal, with its semicircle looks like the sea’s two stretched out branches, separates the suburbs from the old city, is stirred up by the surging of the waves and spreads in all directions a thick, disgusting odour of all the industries, dissolved refuse, mixed together. The water is black and shiny like fish oil, but gradually, as the industries begin to empty their wastewater, spots of different colours arise around the mouth of the sewers, and each of these spots smells in its own way until it flows together with the others. Here all kinds of industries vomit their waste, weaving mills, spinning mills, workshops, lime-works, slaughterhouses, oil mills, laundries and tanneries, industries which in turn produce chocolate, candy, margarine, macaroni, sausages, mustard, polishing lubricants, vinegar, matches, cigars, lightning conductors, ink, guano, soaps and perfumes. The actual bouquet from all of this is present in the gutters, the contents of which flow slowly along the canal banks. This is how the atmosphere of the city is formed. (14).

In order to protect the city canal the Borough Finance Department decided to regulate private sewers. More and more pipes were laid in the city—in 1889 there were over 21 000 m and 5 years later another 4000 m. In 1895, one year after Danielsson’s vivid description was published, the city council ordered slaughterhouses, tanneries, and similar factories to construct cesspools for the disposal of solid waste. In accordance with the Borough Finance Department’s decision, sewers carrying wastewater containing particularly unhealthy or toxic substances, for example, from the gasworks, were to be equipped with special filters.

The sewage issue was brought up for discussion in conjunction with the decision of the water-pipe issue (15). In 1899, H. Holmberg, the chief engineer of the city, was instructed by the Borough Finance Department to design a sewerage system. Important questions needed to be answered. Should human excrements be included in addition to the wastewater? Should the system be planned as a combined or as a separate system? Was it possible to discharge untreated sewage into the sea? Was it necessary to treat the sewage, and if so in what manner?

Holmberg presented his plan in 1902. The canals were to be cleansed of wastewater, and collector sewers were to be led to a pump station in an eastern suburb; their contents would then be discharged via a pressure pipe into the Lomma Bay, outside Malmö, at a depth of at least 1.5 m. The wastewater was thought to be made innocuous by diluting it and allowing it to be carried away by the currents in Öresund. No wastewater treatment was proposed by Holmberg, but he mentioned that irrigation fields had been discussed. He advised, however, that wastewater treatment was not needed for economic reasons unless “pollution problems in the Lomma Bay made it an urgent necessity” (16).

Ambt pointed out that no dilution of wastewater would take place in the Lomma Bay at a water depth of 1.4 m. He recommended the construction of a septic tank to remove some of the sludge by sedimentation (17). However, a much better result could be obtained if a filter was connected to the tank. Ambt’s criticism prompted Holmberg to go to England with Formmark, the city physician, to study septic tanks. That journey was important. When Holmberg presented his new proposal in 1904 a septic tank was included in the plan. The plant was to be constructed on the Sege River, which would take away the treated wastewater and dilute it before it reached the sea. Holmberg proposed that an area of about 5 hectares would be reserved for filter beds if further treatment was needed in the future. He was probably influenced by Ambt, who thought that as Copenhagen did not treat its wastewater at all, a septic tank was enough for a little city such as Malmö (18).

Formmark, the city physician, regarded a filter to be necessary as “during warm and dry summers it seems not unlikely to me that this considerable amount of wastewater, which would continuously be discharged into the Lomma Bay, would probably soon cause it to be in a similar condition to that of the canal at
present" (19). When Fornmark spoke in favor of wastewater treatment he wanted to avoid turning Lomma Bay into a stinking, unhealthy body of water.

In the autumn of 1904, the city council accepted Holmberg's proposal. When the sewage system was completed 4 years later, it did not include a wastewater-treatment plant. Engineer Holmberg had suddenly died and a professor at the Royal Institute of Technology in Stockholm, J. Gust. Richert, son of J. G. Richert (see above), took responsibility for the project. Richert was not convinced of the benefit of a septic tank. He wanted to postpone its construction and instead gradually work out a more suitable treatment method. In June of 1905, his revised proposal was accepted by the city council (20). The sewage system was completed in 1908.

**THE WATER CLOSET QUESTION**

During the dysentery epidemic of the early 1880s, the Board of Health had called attention to the improper handling of the waste from the privies. Many of these privies were just holes in the ground and leakage was common. This system was gradually replaced by barrels, but a better solution was called for in the beginning of the 1890s (21). Generally, the water-closet system was considered to be this better solution, and the Board shared this view: "For cities the introduction of the water closet system is a large economic gain, it is the cheapest disposal system and for cleanliness and health the most complete and the most satisfactory system" (22).

The first water closets in Malmö were installed in a hotel in 1887. But the Board of Health was still very restrictive, because there was no cutoff sewerage system and the waste would end up in the canal. Malmö also had built a special factory, on the outskirts of town, to evaporate liquid from human excrements collected in barrels in order to make fertilizer, poudrette, for agriculture. The use of water closets would also affect the production of poudrette negatively, as fertilizing matter would be lost. In 1895, the city council forbade the use of water closets (23).

Water closets were introduced while the sewerage system was under construction. This opportunity had been eagerly awaited. Since 1903, the Board of Health had received a stream of applications. In the autumn of 1906, C. H. Meurling, the engineer of the Borough Finance Department, claimed that the main arguments against the use of water closets had disappeared and that, due to the new collector sewers, the sewage no longer threatened the canals. According to Meurling, poudrette made only a little profit. Regarding the lower quality of fertilizer he says, "Eventually concerning the economic loss that is inflicted on the soil by the withdrawal of some valuable fertilizing substances, it might not be regarded as considerable, especially considering today's extensive industry producing artificial fertilizing substances" (24).

In January 1908, the same year the construction of the sewage system was finished, the city council accepted installation of water closets. In 1907, there were 78 water closets in the city, in 1908 763, and in 1914 the number was 3853. In 1908, Malmö
had 80 000 inhabitants and 144 industrial plants. This population and industrial development affected the city’s water consumption and the amount of wastewater it generated.

The new sewage system, which consisted of municipal sewers and private water closets, made Öresund a discharge recipient, and the discharges became more diffuse and invisible. This and the resulting difficulties in identifying the sources of pollutants may explain why individual industries were very rarely targets of criticism from authorities. But the issue of water pollution was brought to the fore much quicker than anyone had expected. Already in the summer of 1911 there were complaints from the municipality of Arlöv, which is located next to Malmö, about “the insufferable stench” that had spread from the Sege River to the local community, endangering the health of the local inhabitants. As the reason for the stench was the wastewater from Malmö, the water pollution problem had been transformed from a local to a regional issue.

**WATER POLLUTION IN GOTHENBURG AND STOCKHOLM**

The pollution situation in Malmö was not unique in Sweden. Urbanization and industrialization during the 19th century had given rise to sanitary and hygienic problems in several places. The situation for the two other biggest cities in Sweden, Gothenburg and Stockholm is described briefly below.

Gothenburg was the second largest city in Sweden with 76 000 inhabitants in 1880 (about twice the number in Malmö). The situation in Gothenburg resembled in many ways the situation in Malmö. In the city center there were canals which had once been part of the ramparts of the city. The city council decided in 1866 to build an underground sewer system. The proposal, which was worked out by J.G. Richert, suggested that wastewater was to be discharged via the sewer system into the moat and the canals of the city. Nevertheless, Richert would have preferred wastewater to be treated first and then pumped into the Göta River, the main surface watercourse near the city (25). Instead untreated wastewater was directed to the canals, which caused serious problems. As a consequence, intercepting sewers had to be built to direct wastewater into the river. The first intercepting sewer was completed in 1887 and a second in 1917 (26). The Göta River became the main recipient of untreated wastewater from Gothenburg. In Malmö, this intercepting sewage system led to the general introduction of water closets.

In the capital of Sweden, Stockholm, the population increased between 1850 and 1900 from 93 000 to 300 000 inhabitants. As in Gothenburg, Stockholm began to plan a sewage system in the 1860s. In Stockholm, pollution problems soon emerged in the urban watercourses. Pollution was one reason among others why the city council resisted the introduction of water closets for decades. But as in Malmö and Gothenburg, the city council of Stockholm withdrew its resistance to water closets at the beginning of the 20th century (27). Consequently, the number of WCs increased rapidly. In 1915, there were more than 50 000 WCs in Stockholm, compared to about 5000 in Gothenburg and nearly 4000 in Malmö.

These examples of the 3 largest cities in Sweden prove that the change in attitudes towards urban water and wastewater management was not dependent on the large size of the city, as it varied considerably. Instead the change in urban mentality seems to have taken place due to access to new technology—intercepting sewers, decomposition wells, improved wastewater purification technology—and due to statements from experts on the ability of the recipients to dilute and purify urban discharge.

**CONCLUSIONS**

The threats to the urban watercourses in Malmö increased during the 19th century in pace with considerable population growth and industrial production while wastewater and waste loading increased considerably in the city. The struggle of the citizens of Malmö for a cleaner urban environment was above all aimed atrendering this filth harmless, which gave rise to the polluted, stinking and, as was thought at that time, unhealthy canal water. Water pollution started in the very center of the city.

The measures that were taken in this struggle were determined by a number of factors, especially the interests, knowledge, values and power of the people involved. The main conflict was between municipal health authorities and private business owners. The Board of Health emphasized hygienic aspects, general well-being and the health of the townspeople. A majority of the municipal decision-makers in the city administration and the city council was against the prohibition of wastewater discharges that seemed to impede good economic and industrial development. Hence, it was easier to accept measures that were designed to reduce the consequences of the water pollution problem than to reduce the polluting load. Consequently, there was continuity in the measures from the 1850s to the beginning of the 20th century, from widening of canals to the construction of a sewerage system and the implementation of water closets.

One important question was whether wastewater should be treated before being discharged. Four different options were debated: i) no treatment; ii) treatment by irrigation; iii) treatment by a septic tank; and iv) treatment by a septic tank combined with a filter system. The most important argument among experts and decision-makers who wanted to play down the significance of wastewater treatment was that Öresund would purify itself through dilution. To use a costly advanced treatment method was, therefore, unnecessary. The city chose the cheaper alternative; a long pipe laid directly into Öresund. It would take until 1963 before Malmö installed a sewage-treatment system.

**References and Notes**

CMA = City of Malmö Archives

1. See for instance CMA: The archive of the board of health, the city physician in Malmö, journals of 1855–56.
2. CMA: The archive of the municipal court, minutes of 9 October 1819.
3. CMA: The archive of the city administration, enclosed documents in the city administration’s minutes, January–June 1852.
5. CMA: The archive of the city administration, minutes of 20 May 1874.
6. CMA: The archive of the board of health, minutes of 14 May 1877.
7. CMA: The archive of the city council, minutes of 7 April and 25 September 1871.
8. CMA: The archive of the city council, minutes of 2 September 1872.
10. CMA: The archive of the board of health, minutes of 21 and 28 August 1882.
12. CMA: The archive of the city council, minutes of 19 January 1883.
13. CMA: The archive of the Joint Borough Finance Department, minutes September 1886 and copy book number 18, 1886.
15. CMA: The archive of the city council, minutes of 3 December 1886.
16. CMA: The archive of the Joint Borough Finance Department, minutes of 23 October 1902.
17. CMA: Appendix to the minutes of the city council, number 38 1902, p. 87–88.
18. CMA: See Appendix to the minutes of the city council 1904, p. 42. An official letter from Ambt to the Joint Borough Finance Department in Malmö, 15 October 1903.
19. CMA: Appendix to the minutes of the city council, 1904.
20. CMA: The archive of the city council, minutes of 9 June 1905.
21. CMA: The archive of the board of health, the board’s comments to the health council, 1875–93.
23. CMA: The archive of the city council, minutes of 18 October 1895.
24. CMA: Appendix to the minutes of the city council, number 337 1907, p. 7.

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